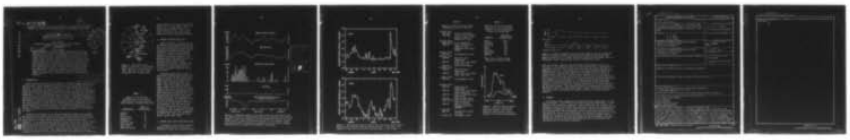
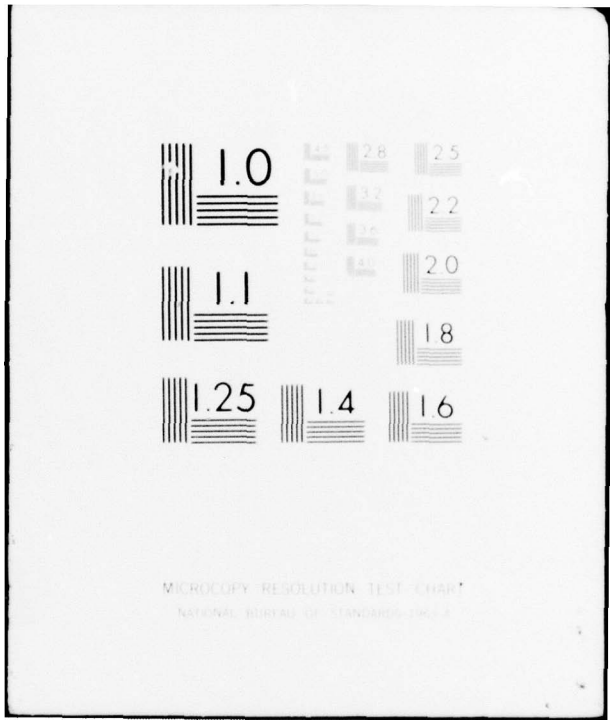
AD-A043 897 AIR FORCE GEOPHYSICS LAB HANSCOM AFB MASS F/G 3/2
A SUMMARY OF SIGNIFICANT SOLAR-TERRESTRIAL AND INTERPLANETARY E--ETC(U)
1976 M A SHEA, D F SMART, H E COFFEY

UNCLASSIFIED AFGL-TR-77-0191 NL

| OF |
AD
A043897



END
DATE
FILMED
9 -77
DDC


1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.5
1.8
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

A SUMMARY OF SIGNIFICANT SOLAR-TERRESTRIAL AND INTERPLANETARY EVENTS DURING THE RETROSPECTIVE WORLD INTERVAL OF 20 MARCH — 5 MAY 1976

M. A. Shea and D. F. Smart
Air Force Geophysics Laboratory
Bedford, Massachusetts 01731, USA

H. E. Coffey
World Data Center A for Solar-Terrestrial Physics
Boulder, Colorado 80302, USA

Solar activity in a region at Carrington Longitude 45° was associated with several interplanetary and terrestrial disturbances that occurred from 20 March to 5 May 1976. These events, which included a ground-level solar cosmic ray increase, were relatively unusual in that they occurred during solar minimum. At the request of the SCOSTEP project on the Study of Travelling Interplanetary Phenomena, this period was designated as a "Retrospective World Interval" resulting in a special publication of solar-terrestrial physics data in a UAG report. Since this project was international in scope and one in which many cosmic ray physicists participated, a summary of the interesting events of this period is presented.

1. INTRODUCTION

Solar minimum, defined as the minimum of a 13-month running average of the Zurich sunspot number, apparently occurred the last four months of 1975 and the first nine months of 1976 with March 1976 being statistical "sunspot minimum". Ironically, the period 20 March - 5 May 1976 was very active for a solar minimum period, primarily with solar activity in a region at Carrington Longitude 45° that was associated with several interplanetary and terrestrial disturbances. This solar activity occurred within a previously designated period of special solar-terrestrial physics studies. Under the organizational sponsorship of the Special Committee on Solar-Terrestrial Physics (SCOSTEP), the Study of Travelling Interplanetary Phenomena (STIP) project had designated the period 15 March - 15 May 1976 as "STIP Interval II", primarily because of the possibility of obtaining extensive and hitherto unavailable particle, plasma, and magnetic field observations from two space probes very close to the sun. The orbits of these two probes, Helios 1 and Helios 2, are shown in Figure 1.

Preliminary evaluation of the solar-terrestrial activity that occurred during this period together with the data acquired by various ground-based and satellite detectors resulted in a request from the STIP project that the period 20 March - 5 May 1976 be designated as a "Retrospective World Interval". In conjunction with the formal declaration of this interval by the SCOSTEP Monitoring Sun-Earth Environment Committee, World Data Center A for Solar-Terrestrial Physics in Boulder, Colorado, USA, offered to publish a special UAG data report presenting significant solar-terrestrial physics data acquired during this period. Data contributions were solicited from the scientific community with the proviso that data to be published be confined to

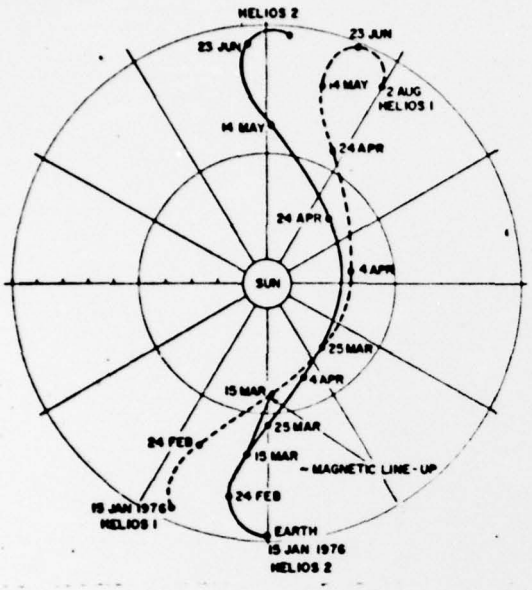


Figure 1. The orbits of the Helios 1 and Helios 2 space probes with respect to a fixed earth-sun line. The time period is from 15 January 1976 to August 1976.

TABLE 1

Number of Contributions by Discipline, to the Special UAG Report on the Retrospective World Interval, 20 March-5 May 1976

Discipline	Number of Contributions
Airglow	1
Aurora	1
Cosmic Rays	11
Geomagnetism	9
Ionosphere	9
Satellite Data	9
Solar Optical	4
Solar Radio	16
Multi-discipline	3

events believed associated with McMath Region 14143 (solar rotation 1639) and its return as McMath Region 14179 (solar rotation 1640). Table 1 presents a summary of the data contributations to this special data report.

2. GENERAL OBSERVATIONAL DATA

Table 2 presents a listing of some of the major solar-terrestrial phenomena that occurred between 20 March and 5 May 1976, particularly those believed associated with McMath Regions 14143 and 14179. Figure 2 is a graphical display of the daily values of solar activity, geomagnetic activity, and neutron monitor intensity for the period of the entire STIP Interval (15 March-15 May 1976). Figure 3 illustrates the >0.2 MeV electron flux and the 2.0-4.6 MeV proton flux observed by the IMP 8 satellite for the same period.

Although McMath Regions 14143 and 14179 were extremely active during this period it should be noted that McMath Region 14143 was on the visible hemisphere from 23 March to 6 April and region 14179 from 20 April to 3 May 1976. During the period 16-22 March, before region 14143 rotated onto the visible solar disk, most of the visible flare activity was from McMath Region 14127 (Carrington Longitude 196°). For the three day period that both McMath Regions 14127 and 14143 were on the visible hemisphere (23-25 March) 56% of the flare activity was from region 14143 on the eastern limb of the visible hemisphere, and 44% from region 14127 on the western limb. For the remaining 11 days of its transit across the visible solar hemisphere, activity in McMath Region 14143 was responsible for 85% of the flare activity on the entire visible solar disk.

3. GROUND LEVEL SOLAR COSMIC RAY EVENT

No attempt will be made to comprehensively discuss each of the solar-terrestrial events that occurred during

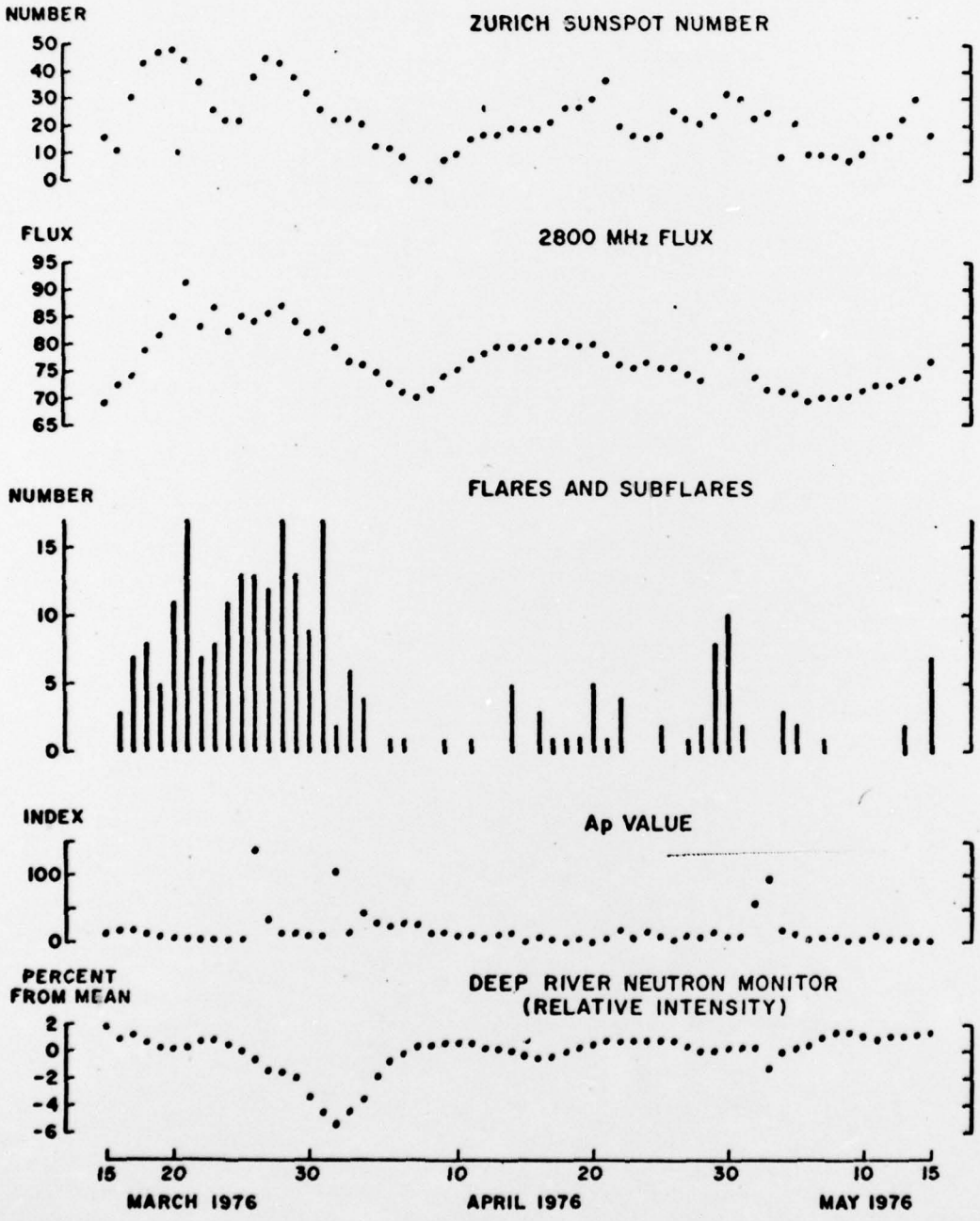


Figure 2. Graphical display of the daily values of the solar activity (as indicated by the Zurich sunspot numbers, the 2800 MHz flux, and the number of flares and subflares), and the geomagnetic activity (as indicated by the A_p index) during STIP Interval II. The relative cosmic ray neutron monitor intensity, as measured by the Deep River, Canada, neutron monitor, is given at the bottom of the figure.

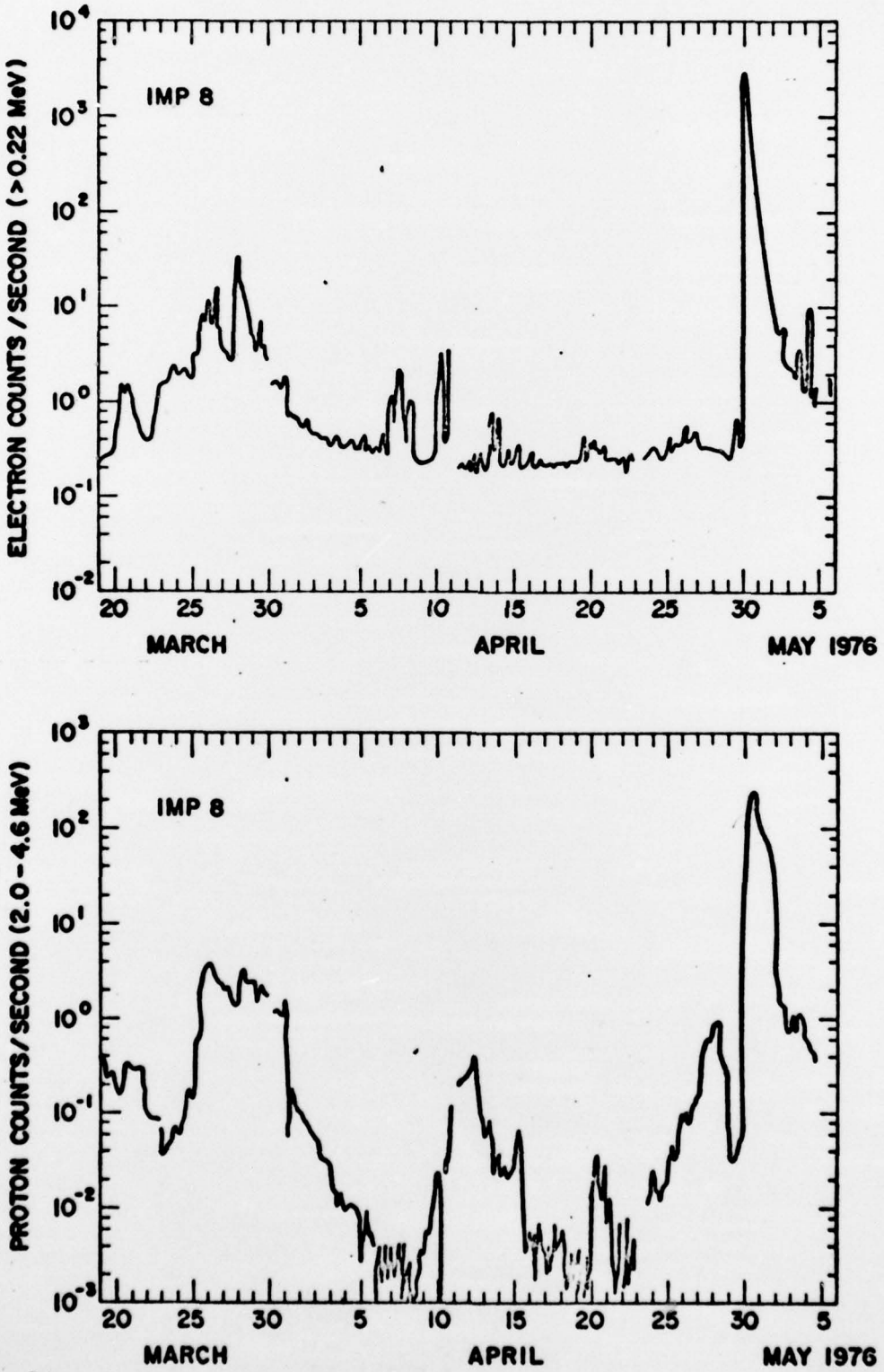


Figure 3. Three-hourly electron (>0.22 MeV) and proton (2.0-4.6 MeV) counting rates from IMP 8 for the period 20 March - 5 May 1976. The largest tic marks are at the end of the date given on the x-axis.

TABLE 2

Summary of Major Solar-Terrestrial Phenomena: 20 March-5 May 1976

20 March 1976	
0203 UT, 2255 UT	Type II radio burst at East Limb (Probable source, region 14143 behind east limb.)
23 March 1976	
0840-1900 UT	X-ray enhancement
1100 UT	Loops observed in H-alpha, SE limb. (Probably from region 14143)
26 March 1976	
0233 UT	SC geomagnetic storm
28 March 1976	
1840 UT	Onset of X-ray enhancement
<1905 UT	Solar flare, 1B, Region 14143, S07, E28.
1921 UT	Type II radio burst
31 March 1976	
1108 UT	Onset of X-ray enhancement
1138 UT	Solar flare, 1N, Region 14143, S07, W09.
1 April 1976	
0255 UT	SC geomagnetic storm
30 April 1976	
2043 UT	Onset of X-ray enhancement
2047 UT	Solar flare, 1B, Region 14179, S08, W46.
2047 UT	Onset of 2800 MHz solar noise burst.
2107 UT	Type II radio burst
2120-2125 UT	Onset of GLE, Inuvik neutron monitor.
2130 UT	Onset of 6-10 MeV protons observed on SMS/GOES
1 May 1976	
0130 UT	Maximum PCA at Thule (2.7 dB)
2-3 May 1976	Geomagnetic storm.

TABLE 3

Relative Solar Proton Increase Observed by Selected Neutron Monitors for the Ground Level Event of 30 April 1976

Station	Relative Increase (%)*
Inuvik	12.0
Kerguelen	11.2
Tixie Bay	7.4
Alert	4.4
Thule	4.4
Goose Bay	2.7
Deep River	2.7
McMurdo	2.7

*Base line = Hourly average intensity for 2000-2100 UT.

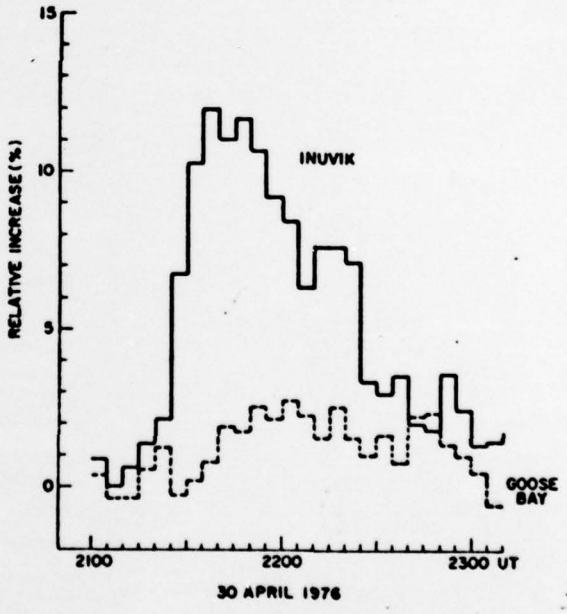


Figure 4. Relative neutron monitor increase observed at Inuvik and Goose Bay, Canada. The cutoff energy at both stations is determined by the intervening atmosphere.

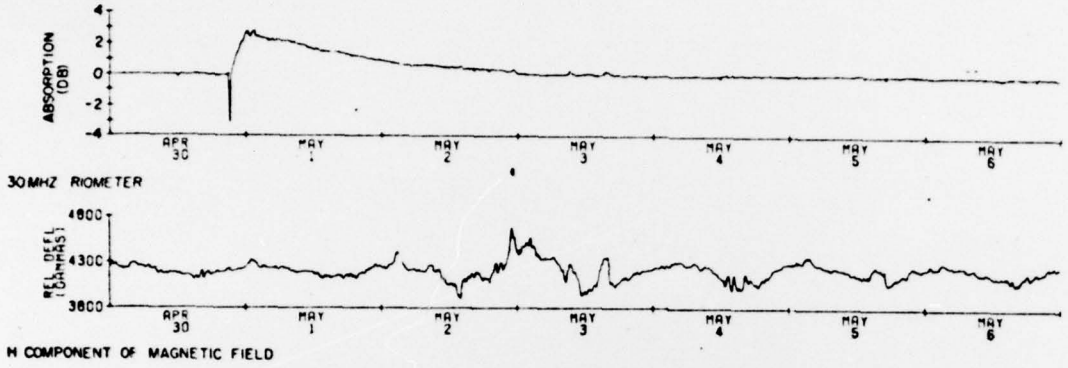


Figure 5. Riometer absorption and horizontal component of the geomagnetic field as observed at Thule, Greenland from 30 April through 6 May 1976. (Figure courtesy of E. A. Lewis, Deputy for Electronic Technology, Rome Air Development Center, Hanscom AFB, Bedford, Massachusetts, USA.)

this time period. However, the ground-level solar cosmic ray event on 30 April is of specific interest to cosmic ray physicists. This event was associated with a 1B flare at 2047 UT at 46° West of central meridian in McMath Region 14179. From examination of the neutron monitor data from 10 locations, the earliest onset appears to be between 2120 and 2125 UT at Inuvik, Canada, which also has the largest increase of 12% as listed in Table 3. The relativistic particle flux in this event was quite anisotropic as illustrated by a comparison of the relative increases at Inuvik and Goose Bay, Canada, as shown in Figure 4. At lower energies there was a rapid increase of electron and proton flux as observed on the IMP 8 satellite (Figure 3) and in the polar cap a maximum absorption of 2.7 dB was measured by the Thule riometer. The relatively modest low energy particle increase observed by IMP 8 and comparatively small riometer absorption, combined with the ground level neutron monitor increase, indicate a very hard particle spectrum.

4. SUMMARY

An extensive data compilation of solar-terrestrial observations for the period 20 March - 5 May 1976 has been compiled by World Data Center A at the request of the scientific community. Data compilations such as these are extremely valuable for research and analyses as the data are either published in detail or summarized in one single document. Many cosmic ray physicists have contributed to data compilations such as these while still more cosmic ray physicists utilize these compilations for various research projects. All members of the IUPAP cosmic ray community are invited to suggest similar periods for comprehensive data collections, and to participate in the data collection process by contributing appropriate data for publication and utilization by the scientific community.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: AFGL-TR-77-0191	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): A SUMMARY OF SIGNIFICANT SOLAR-TERRESTRIAL AND INTERPLANETARY EVENTS DURING THE RETROSPECTIVE WORLD INTERVAL OF 20 MARCH - 5 MAY 1976	5. TYPE OF REPORT & PERIOD COVERED: Scientific - Interim
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): M. A. Shea, D. F. Smart *, H. E. Coffey	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Air Force Geophysics Laboratory (PHG), Hanscom Air Force Base, Massachusetts 01731	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: ~~IIWU~~ 2311G101, 61102F
11. CONTROLLING OFFICE NAME AND ADDRESS: Air Force Geophysics Laboratory (PHG), Hanscom Air Force Base, Massachusetts 01731	12. REPORT DATE: 2 September 1977
	13. NUMBER OF PAGES: 6
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Reprint from 15th International Cosmic Ray Conference, Conference Papers, 5, 246, 1977

*World Data Center A for Solar-Terrestrial Physics, NOAA, Boulder, CO.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

solar-terrestrial physics
solar activity
solar particles
solar cosmic ray event
polar cap absorption

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Solar activity in a region at Carrington Longitude 45 degs was associated with several interplanetary and terrestrial disturbances that occurred from 20 March to 5 May 1976. These events, which included a ground-level solar cosmic ray increase, were relatively unusual in that they occurred during solar minimum. At the request of the SCOSTEP project on the Study of Travelling Interplanetary Phenomena, this period was designated as a "Retrospective World Interval" resulting in a special publication of solar-terrestrial physics data in a UAG report. Since this project was international in scope and one in which many cosmic ray

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

physicists participated, a summary of the interesting events of this period is presented.